

What is claimed is:

1. An electron beam device comprising:

an electron beam source for emitting an electron beam;

an electron optical system for directing said electron beam onto a  
5 specimen;

a specimen holder for holding said specimen;

a specimen tilting section for producing a relative tilt angle between  
said specimen holder and said incident electron beam;

an electron beam detecting section for detecting electron beams emitted  
10 from said specimen; and

a data correcting section for correcting the three-dimensional detection  
data to have specified relationship under the condition of a relative tilt angle  
between said specimen holder and said electron beam.

2. An electron beam device according to claim 1, wherein said specimen  
15 tilting section is adapted to tilt said specimen relative to said incident  
electron beam.

3. An electron beam device according to claim 1, wherein said specimen  
tilting section is adapted to control said electron optical system so that said  
incident electron beam is irradiated onto said specimen at tilted angles.

20 4. An electron beam device according to claim 1, wherein said electron  
beam detecting section is adapted to detect secondary electrons emitted from  
said specimen.

5. An electron beam device according to claim 1, wherein said specimen  
has reference marks serving as reference positions; and

25 said data correcting section uses said reference marks to correct  
deviation of said three-dimensional detection data into rectified data.

6. An electron beam device according to claim 1, wherein said data  
correcting section comprises:

a rectifying parameter acquiring means for acquiring rectifying

parameters at relative tilt angles between said specimen holder and said incident electron beam for acquiring said three-dimensional detection data using reference marks on a reference template; and

an image data rectifying means for correcting said three-dimensional  
5 detection data into rectified data using said rectifying parameters acquired.

7. An electron beam device according to claim 1 further comprising:

at least one of a shape measuring section for measuring the shape of said specimen on the basis of the data corrected with said data correcting section and a stereovision section for forming three-dimensional images of said  
10 specimen on the basis of the data corrected with said data correcting section.

8. A data processing device for an electron beam device, connected to said electron beam device, said electron beam device having an electron beam source for emitting an electron beam, an electron optical system irradiating said electron beam onto a specimen, a specimen holder for holding said  
15 specimen, a specimen tilting section for mutually tilting said specimen holder and said electron beam, and an electron beam detecting section for detecting electron beams emitted from said specimen, said data processing device comprising: a data correcting section for receiving and correcting said three-dimensional detection data into data having specified relationship.

20 9. A data processing device for an electron beam device according to claim 8, further comprising:

at least one of a shape measuring section for measuring the shape of said specimen on the basis of the data corrected with said data correcting section and a stereovision section for forming three-dimensional images of said  
25 specimen on the basis of the data corrected with said data correcting section.

10. A method of forming three-dimensional data of an electron beam device for measuring the shape of a specimen or for forming a three-dimensional image of said specimen using an electron beam device having an electron beam source for emitting an electron beam, an electron optical

system for irradiating said electron beam onto a specimen, a specimen holder for holding said specimen, a specimen tilting section for relatively tilting said specimen holder and said incident electron beam, and an electron beam detecting section for detecting electron beams emitted from said specimen, comprising:

said specimen being formed with reference marks serving as reference positions;

detecting first detection data with said electron beam detecting section in the state of a first relative tilt angle between said specimen holder and said incident electron beam;

detecting second detection data with said electron beam detecting section in the state of a second relative tilt angle between said specimen holder and said incident electron beam; and

Correcting said first and second detection data into rectified data using said reference marks.

11. A method of forming three-dimensional data of an electron beam device for measuring the shape of a specimen or for forming a three-dimensional image of said specimen using said electron beam device having an electron beam source for emitting an electron beam, an electron optical system for irradiating said electron beam onto a specimen, a specimen holder for holding said specimen, a specimen tilting section for tilting said specimen holder relative to said incident electron beam, and an electron beam detecting section for detecting electron beam emitted from said specimen, comprising:

in place of said specimen, inserting a reference template formed with reference marks serving as reference positions onto said specimen holder;

detecting first and second detection data related to said reference template with said electron beam detecting section under conditions of first and second relative tilt angles between said specimen holder and said incident electron beam;

acquiring rectifying parameters using said reference marks at relative tilt angles between said specimen holder and said incident electron beam;

inserting said specimen onto said specimen holder;

detecting first and second detection data related to said specimen with  
5 said electron beam detecting section under conditions of first and second relative tilt angles between said specimen holder and said incident electron beam; and

correcting said first and second detection data into rectified data using said rectifying parameters acquired.

10 12. A data processing device for an electron beam device, connected to said electron beam device, said electron beam device having an electron beam source for emitting an electron beam, an electron optical device irradiating said electron beam onto a specimen, a specimen holder for holding said specimen, a specimen tilting section for mutually tilting said specimen holder  
15 and said electron beam, and an electron beam detecting section for detecting electron beams emitted from said specimen; said data processing device comprising:

a measurement condition judging section for receiving the conditions for measuring with said electron beam device; and

20 a shape measuring section that receives data detected with said electron beam detecting section at different relative tilt angles caused with said specimen tilting section between said specimen holder and said incident electron beam, and measures the shape of said specimen in three dimensions on the basis of measurement conditions judged with said measurement  
25 condition judging section.

13. A data processing device for an electron beam device according to claim 12, wherein said measurement condition judging section judges measurement conditions using at least one of the information on the type of said electron beam device and the information on the magnification of said

electron optical system.

14. A data processing device for an electron beam device according to claim 13, wherein said specimen has reference marks serving as reference positions; and

5        said shape measuring section measures the shape of said specimen in three dimensions in the state of differences in distortion and in scale, due to said tilt angles and contained in detected data at said different tilt angles, corrected on the basis of reference marks contained in the data detected at said different tilt angles.

10       15. A data processing device for an electron beam device according to claim 12, wherein said specimen has reference marks serving as reference positions; and

15       said shape measuring section measures the shape of said specimen in three dimensions in the state of differences in distortion and in scale, due to said tilt angles and contained in detected data at said different tilt angles, corrected on the basis of reference marks contained in the data detected at said different tilt angles.

16. A data processing device for an electron beam device according to claim 12, further comprising: a rectifying parameter acquiring means that  
20       acquires rectifying parameters for correcting differences in distortion and in scale due to said tilt angles contained in the data detected at said different tilt angles using reference marks on a reference template;

25       an image data rectifying means that corrects differences in distortion and in scale due to said tilt angles contained in the data detected at said different tilt angles using said rectifying parameters acquired; and

      said measuring section measures the shape of said specimen in three dimensions using the data detected at different tilt angles and corrected with said image data rectifying means.

17. A data processing device for an electron beam device according to

claim 16, wherein

the reference marks of said reference template are provided in relation to at least two types of height;

5 said rectifying parameter acquiring means further acquires lens distortion correcting parameters for correcting the lens distortion of said electron optical system; and

said image data rectifying means further corrects the lens distortion contained in the data detected at said different tilt angles using said lens distortion correcting parameters.

10 18. A method of measuring a specimen in three dimensions using an electron beam device having an electron beam source for emitting an electron beam, an electron optical system for directing said electron beam onto said specimen, a specimen holder for holding said specimen, a specimen tilting section for producing a relative tilt angle between said specimen holder and  
15 said incident electron beam, and an electron beam detecting section for detecting electron beams emitted from said specimen, comprising:

said specimen being formed with reference marks serving as reference positions;

detecting first detection data with said electron beam detecting section  
20 in the state of a first relative tilt angle between said specimen holder and said incident electron beam;

detecting second detection data with said electron beam detecting section in the state of a second relative tilt angle between said specimen holder and said incident electron beam; and

25 measuring the shape of said specimen in three dimensions on the basis of the reference marks contained in said first and second detection data in the state of the differences, in distortion and scale due to differences in said first and second relative tilt angles and contained in said first and second detection data, corrected.

19. A method of measuring a specimen in three dimensions using an electron beam device having an electron beam source for emitting an electron beam, an electron optical system for directing said electron beam onto said specimen, a specimen holder for holding said specimen, a specimen tilting section for producing a relative tilt angle between said specimen holder and said incident electron beam, and an electron beam detecting section for detecting electron beam emitted from said specimen, comprising:

in place of said specimen, inserting a reference template formed with reference marks serving as reference positions onto said specimen holder;

detecting first and second detection data related to said reference template with said electron beam detecting section under conditions of first and second relative tilt angles between said specimen holder and said incident electron beam;

acquiring, using said reference marks, rectifying parameters for correcting the differences in distortion and in scale, due to differences in said first and second relative tilt angles and contained in said first and second detection data;

inserting said specimen onto said specimen holder;

detecting first and second detection data related to said specimen with said electron beam detecting section under conditions of first and second relative tilt angles between said specimen holder and said incident electron beam; and

measuring the shape of said specimen in three dimensions in the state of the differences, in distortion and scale due to differences in said first and second relative tilt angles, corrected.

20. A method of manufacturing reference templates using an electron beam device having an electron beam source for emitting an electron beam, an electron optical system for directing said electron beam onto said specimen, a specimen holder for holding said specimen, a specimen tilting section for

producing a relative tilt angle between said specimen holder and said incident electron beam, and an electron beam detecting section for detecting electron beam emitted from said specimen, comprising:

placing a reference template on said specimen holder;

5 moving and irradiating said electron beam to positions on said reference template where reference marks are to be formed; and

forming reference marks on said reference template on the basis of the electron beams detected with said electron beam detecting section.

21. A method of preparing reference templates according to claim 20,  
10 wherein said reference marks are formed with at least four points of contamination or defects.

22. A method of preparing reference templates according to claim 20,  
wherein forming said reference marks is deemed to be completed when signals  
of electron beams detected with said electron beam detecting section reaches a  
15 predetermined level.

23. A method of preparing reference templates according to claim 20,  
wherein the electron beam for forming said reference marks is made greater in  
diameter than the electron beam for detecting the images of said specimen  
using said electron beam detecting section in said electron beam device.

20 24. A method of preparing reference templates according to claim 20,  
wherein the electric current value for the electron beam for creating said  
reference marks is controlled to be greater when said reference marks are  
being formed than when said electron beam is being moved over said reference  
template.

25 25. A reference template prepared using an electron beam device having  
an electron beam source for emitting an electron beam, an electron optical  
system for directing said electron beam onto said specimen, a specimen holder  
for holding said specimen, a specimen tilting section for producing a relative  
tilt angle between said specimen holder and said incident electron beam, and



an electron beam detecting section for detecting electron beam emitted from said specimen, in the steps of:

(i) placing said reference template on said specimen holder;

(ii) moving and irradiating said electron beam to the positions on said  
5 reference template where reference marks are to be formed; and

(iii) forming reference marks on said reference template on the basis of the electron beam detected with said electron beam detecting section.